IG-00-037

REVIEW REPORT

REVIEW OF RESEARCH FLIGHT OPERATIONS AT THE GLENN RESEARCH CENTER

July 17, 2000

National Aeronautics and
Space Administration

OFFICE OF INSPECTOR GENERAL

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Acronyms

AOS	Aviation Operations System
FAA	Federal Aviation Administration
IAOP	Intercenter Aircraft Operations Panel
NPG	NASA Procedures and Guidelines

W July 17, 2000

TO: A/Administrator

FROM: W/Inspector General

SUBJECT: INFORMATION: Review of Research Flight Operations at the Glenn Research Center
Report Number IG-00-037

The NASA Office of Inspector General has completed a review of the decision to terminate Research Flight Operations at the Glenn Research Center (Glenn). We performed the review in response to Center employee and congressional concerns over the termination of research flights based at the Glenn. We found that NASA terminated research flight operations at Glenn prematurely without adequately evaluating all of the alternatives, performing cost-benefit analyses, or developing a long-term plan for conducting the icing research. As a result, the cost of conducting the research could increase if the planes are transferred to another location, and there will be a loss of productivity for the researchers involved in Glenn's research flight activities.

Background

Since about 1970, Glenn has provided aircraft operations for various flight research aircraft. However, the Agency's Zero Based Review[1] completed May 17, 1995, recommended the consolidation of all NASA research aircraft. Glenn had 10 aircraft at the time and took appropriate measures to either transfer most of them to other NASA Centers or surplus them. Glenn currently has two remaining aircraft, a DeHavilland Twin Otter and a Lear 25. The Twin Otter serves as NASA's icing research aircraft, which was modified to meet the requirements of a flying icing laboratory and experimental aircraft. The Lear 25 has been modified to serve many functions for NASA and other Government agencies. During our review, NASA used the aircraft primarily for solar cell calibration.[2]

[1] NASA performed the Zero Based Review of each NASA program to determine ways to restructure programs in order to accomplish major scientific objectives for less money.
[2] NASA uses the solar cells to provide power to satellites.

Recommendations

We recommended that the Associate Administrator for Aerospace Technology (1) develop a long-term plan for the icing research program that provides for safe and effective research performance, (2) perform a safety and programmatic evaluation including a cost-benefit analysis of alternatives for performing the flight research program, (3) suspend aircraft transfer plans until a cost-benefit analysis of the alternatives has been performed, and (4) consider resumption of Glenn research flight operations after a follow-on assessment is performed.

Management's Response

Management concurred with the findings and recommendations. The Associate Administrator for Aerospace Technology is revising the icing research project plan and evaluating alternatives, including conducting a cost-benefit analysis to appropriately assess the resources needed to meet the project goals. In addition, the Associate Administrator has agreed that there will be no transfer of aircraft from the Center prior to completion of the project plan and a cost-benefit analysis. The Center will also continue to conduct flight operations to maintain the minimum airworthiness of the aircraft and the flying proficiency for its pilots.

Details on the status of the report recommendations follow the finding discussion.

[original signed by]
Roberta L. Gross

Enclosure
Final Report on Review of Research Flight Operations at the Glenn Research Center

FINAL REPORT
REVIEW OF RESEARCH FLIGHT OPERATIONS
AT THE GLENN RESEARCH CENTER

W July 17, 2000

TO: R/Associate Administrator for Aerospace Technology
0100/Director, Glenn Research Center

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Report on Review of Research Flight Operations at Glenn Research Operations
Assignment Number A0002700
Report Number IG-00-037

The subject final report is provided for your information and use. Please refer to the Results in Brief for the overall review results. Our evaluation of your response is incorporated into the body of the report. The recommendations will remain open for reporting purposes until corrective action is completed. Please notify us of the actions taken, including the extent of testing performed to ensure corrective actions are effective.

If you have questions concerning the report, please contact Ms. Karen VanSant, Program Director, Aerospace Technology Audits, at (256)-544-1149, or Mr. William Falter, Auditor-in-Charge, at (301)-286-3356. We appreciate the courtesies extended to the audit staff. See Appendix C for the report distribution.

[Original signed by]

Russell A. Rau

Enclosure

cc:
B/Chief Financial Officer
B/Comptroller
BF/Director, Financial Management Division
G/General Counsel
JM/Acting Director, Management Assessment Division

NASA Office of Inspector General

IG-00-037 **July 17, 2000**
A0002700

Review of Research Flight Operations at the Glenn Research Center

Introduction

The NASA Office of Inspector General (OIG) completed a review of Research Flight Operations at the Glenn Research Center (Glenn). The former Associate Administrator for Aerospace Technology directed the Center to discontinue research flight operations[3] as of December 31, 1999. Due to programmatic requirements, one of the two research aircraft was granted an extension of operations until March 31, 2000. We initiated the review due to Center employee and congressional concerns about the termination of research flights at Glenn. The overall objective of our review was to evaluate NASA's decision to discontinue research flight operations at Glenn. See Appendix A for the specific review objectives.

Results in Brief

NASA prematurely terminated research flight operations at Glenn without adequately evaluating all the alternatives, performing cost-benefit analyses, or developing a long-term plan for conducting the icing research. NASA justified the decision to stop research flight operations at Glenn by citing perceived safety concerns related to mechanic proficiency, risky flying conditions, and pilot proficiency. However, subsequent to this decision, NASA did not perform an adequate analysis to validate the perceived safety concerns. In addition, NASA Headquarters and Glenn officials did not clearly communicate regarding the decision to stop the research flights and the long-term direction for the icing research program. As a result, the cost of the research programs will increase, and there will be a loss of productivity for the researchers involved in Glenn's research flight activities.

[3] Glenn performs research on how ice forms on the wings and tail of an aircraft in order to provide training to pilots on how to handle an icing situation.

Background

Since about 1970, Glenn has provided aircraft operations for various flight research aircraft. However, the Agency's Zero Based Review[4] completed May 17, 1995, recommended the consolidation of all NASA research aircraft. Glenn had 10 aircraft at the time and took appropriate measures to transfer most of them to other NASA Centers or to surplus them. Glenn has two remaining aircraft, a DeHavilland Twin Otter and a Lear 25.

Twin Otter and the Icing Research Program. The Twin Otter serves as NASA's icing research aircraft. It has been modified to meet the requirements as a flying icing laboratory and experimental aircraft to meet the long-term validation needs of Glenn's Icing Research Tunnel and icing computational tools. The aircraft's instruments measure icing cloud characteristics; document resultant ice accretions; and determine the performance, stability, and control degradation due to ice contamination. In-flight icing research activities require access to a geographical area with a high probability of atmospheric icing potential, such as Cleveland. The airline industry has used two NASA-produced videotapes on airplane icing to train pilots.

The icing research program at Glenn consists of simulations in the Icing Research Tunnel (the largest refrigerated icing wind tunnel in the world), computational models, and research flights. The research flights serve to validate the results obtained in the tunnel and the models. Accordingly, the flights are an important part of the research program. The need for icing research was emphasized in a November 30, 1998, National Transportation Safety Board report,[5] which states:

> … it is not clear what effect residual ice/ice accretions on unprotected nonleading edge airframe surfaces have on flight handling characteristics. Because not enough is known or understood about icing in general, and especially about the effects of intercycle and residual ice, the Safety Board believes that NASA should (with the FAA [Federal Aviation Administration] and other interested aviation organizations) conduct additional research to identify realistic ice accumulations, to include intercycle and residual ice accumulations and ice accumulations on unprotected surfaces aft of the deicing boots, and to determine the effects and criticality of such ice accumulations; further, the information developed through such research should be incorporated into aircraft certification requirements and pilot training programs at all levels.

Lear 25 and the Solar Cell Calibration Program. The Lear 25 has been based at Glenn since 1980 and has been modified extensively to serve many functions for NASA and other Government agencies. At the time of our review, the primary use of the aircraft was

[4] NASA performed the Zero Based Review of each NASA program to determine ways to restructure programs in order to accomplish major scientific objectives for less money.
[5] The report subject is, "Comair accident, Flight 3272 on January 9, 1997."

for solar cell calibration.[6] The solar cell calibration program will typically fly from 20 to 40 flights from late October through late March when the sun angle and atmospheric conditions are suitable.

The International Space Station will use solar cells. NASA and satellite owners need to know, within a 1-percent tolerance, how well the solar cells will work in space. To make this determination in the laboratory, the researchers need to have a "known" cell[7] as a primary reference. Once the researchers have this standard, they can use a simulator to compare other cells of the same composition. Cells are made of various compositions, so many reference cells are needed as primary references. Glenn officials stated there is a greater need now for the flights than in the past because of the more complex cells being developed. NASA, other Government agencies, and industry use the Glenn research flight aircraft, which has a reputation for providing accurate measurements.

Research Flight Operations

Finding. NASA prematurely terminated research flight operations at Glenn without adequately evaluating all alternatives, performing cost-benefit analyses, or developing a long-term plan for conducting the icing research. NASA justified the decision to stop research flight operations by citing safety concerns. However, the Agency did not perform an adequate analysis to show that the concerns were valid or that the actions taken were in the best interest of the programs. In addition, as a result of the Agency's and Glenn's lack of clear communication on the decision to stop the research flights at Glenn, the research community, members of Congress, and the public were concerned about the stoppage and the long-term direction for the icing research program. Stopping research flight operations before adequately evaluating the impacts on the research and evaluating alternatives may result in increased costs for research and a decrease in research productivity.

Perceived Safety Considerations

The Agency based its decision to stop research flight operations at Glenn on perceived safety concerns related to mechanic proficiency, risky flying conditions, and pilot proficiency.

- NASA was concerned about mechanic proficiency because of the direction to transfer aircraft (Glenn reduced the number of its aircraft from 10 to 3[8]) and because the remaining

[6] NASA uses solar cells in space to provide energy for satellites and space station. The solar cell calibration is performed in the Earth's stratosphere and requires an aircraft that is capable of achieving an altitude high enough to fly approximately 7 to 10 miles above the earth's surface. This cannot be done adequately in a ground laboratory.

[7] A "known cell" is a calibrated cell that is used to check uncalibrated cells.

[8] At the time of the Intercenter Aircraft Operations Panel's review, in addition to the Twin Otter and the Lear 25, Glenn had a third aircraft, an OV-10. However, Glenn did not have any further use for that aircraft in the research program, and the aircraft was subsequently excessed.

research flights were seasonal which together could result in decreased proficiency in maintaining aircraft operability. Because of these concerns, flight operations were stopped. In response to this action, the Glenn Research Center requested the Intercenter Aircraft Operations Panel (IAOP) to conduct a review of Glenn's flight operations in February 1999 which raised some safety questions about management, operations, and maintenance. However, Glenn addressed the IAOP's concerns following its review by implementing IAOP recommendations. The IAOP currently has no safety concerns about the operations at Glenn. Upon satisfying the IAOP's concerns, Glenn resumed flight operations.

- The Office of Aerospace Technology decided NASA pilots should not be flying in the risky conditions because there is little or no control over where icing could occur on the aircraft. Normally, pilots would try to avoid aircraft icing because it affects the handling of the aircraft and is a major cause of aircraft accidents. However, for icing research flights, the pilots fly directly into the icing conditions. Glenn has been performing icing research using aircraft for about 18 years without incident. The pilots are well trained in this type of flying, and they take precautions to avoid problems. Normally, during an icing research flight, there are two pilots and two researchers in the plane. Under the alternative of leasing the Twin Otter to Canada, which NASA is currently considering, Agency researchers will still fly on board during many of the research flights. In addition, NASA pilots will be accompanying some Canadian pilots on icing research flights for a certain period after the transfer. Since NASA personnel will still be flying on the aircraft during the research flights, we believe leasing the Twin Otter to Canada would not alleviate the safety concerns related to flying in risky conditions.

- The Agency was concerned about pilot proficiency. The letter[9] NASA issued in response to congressional concerns about transferring aircraft states, " maintaining a safe flight research operation at GRC [Glenn] requires an investment in maintaining crew proficiency achieved by flying the aircraft on missions over and above that justified by research requirements." NASA Procedures and Guidelines (NPG) 7900.3A, "Aircraft Operations Management," dated April 8, 1999, states that NASA pilots must have at least 100 hours of flight time each year to maintain their proficiency as pilots. Our review of Glenn flight records for calendar year 1999 showed that both the pilots flying research flights at Glenn had more than 100 hours of research flying time each. Therefore, the pilots had met the NPG requirement to maintain proficiency.

Communication on the Decision to Stop Flights

Based on findings and recommendations of the IAOP review team, the Office of Aerospace Technology restored flight operations on March 5, 1999. The Office of Aerospace Technology also requested that Glenn thoroughly review the findings and recommendations of the IAOP team and report on the actions related to proposed minor modifications. The March 5 letter

[9] The Agency issued the February 11, 2000, letter to Senator DeWine.

that restored flight operations also states "this direction to resume operations is valid through calendar year 1999." The last paragraph of the letter states, "you are directed to reinstate flight operations at Glenn and to continue the transition to flight support." The letter did not instruct Glenn to prepare a plan for performing the research if flight operations were discontinued or the aircraft were based elsewhere. Therefore, Glenn officials believed the letter did not require them to stop flight operations at the end of calendar year 1999 and did not begin planning for alternatives for the research. Conversely, the Office of Aerospace Technology officials believed the letter was clear that flight operations at Glenn would stop at the end of 1999. Although communication between Glenn and the Office of Aerospace Technology on this issue continued, it did not result in either closure on the perceived safety issues or the future of the icing research program.

Long-term Program Plan

The former Associate Administrator for Aerospace Technology stated the icing program did not have a long-term plan for conducting research. According to Glenn, icing research is a project within the Aviation Operations (AOS) Systems Research and Technology Base Program element. The AOS program does have a long-term plan, which includes technical objectives, approach, milestones, and schedules, for icing research. The icing research project has prepared a new project plan that is currently under review. The former Associate Administrator for Aerospace Technology also indicated that enough research had been conducted using the Twin Otter aircraft and that Glenn should be moving towards other types of aircraft. Glenn officials stated that they would like to use another aircraft, such as the class of regional jets used by some commuter airlines. However, the program does not have the necessary resources for procuring another aircraft. Although Glenn officials have prepared a draft long-term plan for conducting icing research, the draft plan does not include plans for access to another class of aircraft because of funding constraints. Program officials told us that modification costs and operating costs of another class of aircraft would also have to be considered.

Although the funding is not currently available, Glenn, in preparing the long-term plan, should include options for procuring another class of aircraft so icing research can continue without interruption. Glenn also should consider making an arrangement with industry that would give Glenn access to another class of aircraft.

Alternatives for Conducting the Flight Research

As of March 2000, NASA had not evaluated alternatives for conducting the icing research and solar cell calibration and had not performed a cost-benefit analysis to determine whether terminating Glenn flight research operations was in the best interest of the research program. Subsequent to the decision, Glenn management began to consider various alternatives. However, management was not considering keeping the planes at the Center because the decision to stop research flight operations at Glenn had already been made. At the time of our review, the only cost analysis that NASA had performed was the Zero Based Review in 1995.

That review was the subject of a prior Office of Inspector General audit (see Appendix A for details), which found that the "assumptions and cost savings projections were optimistic, and its associated cost estimates did not adequately reflect actual cost history."

Glenn is pursuing one alternative regarding use of the Twin Otter, which is to lease the aircraft to Canada and to work cooperatively with Canadian researchers in conducting icing research. Under this arrangement, Canada would operate the aircraft but it would be available for use by NASA and Canadian researchers. The Canadians also have Twin Otter aircraft and, therefore, are familiar with its operations; however, the Canadians have not flown research flights similar to those that NASA has flown. NASA has flown performance flight and clear air tests with artificial ice shapes that the Canadians have never flown. The details of the lease, cost, schedule, and the extent of research collaboration with the Canadians have yet to be finalized. Further, it is unclear how such a transfer would enhance safety compared to the present arrangement.

Glenn is considering two options for the Lear 25. One option is to transfer the aircraft to Langley and bring it to Glenn for a few months a year for solar cell calibration flights. Another option is to use an ER-2 aircraft (based at Dryden Flight Research Center), which can fly at altitudes higher than the Lear 25 can fly and, therefore, could be used at various times of the year or at different locations. However, Glenn officials stated that there may be control limitations[10] on the ER-2 aircraft, which could eliminate it from further consideration. The options still need exploring before a final decision is made.

Impacts on Research Programs

Glenn will remain NASA's lead center for icing research and aerospace power research and technology. The research programs will continue even though the applicable aircraft are not based at Glenn. There will be no reduction in staffing because of the decision to cease flight operations. However, there will be some changes in the ways the research is conducted and some related impacts on the research programs. Two of these impacts, the cost of the research and productivity of the researchers, are discussed below.

Cost of Research Could Increase. The Twin Otter and the Lear are the only two research aircraft at Glenn. Staging these two aircraft at another location that is yet to be determined will increase the cost of doing research. Travel costs would be incurred for the Glenn researchers to travel to the locations where the aircraft are based. The additional travel costs are currently estimated at a total of $45,000. In addition, to maximize efficiency when traveling to Canada, the researchers will need to build a hot bench[11] at Glenn estimated to cost $143,000. Also, the Twin Otter may need to be modified to meet Canada Transport (Canada's Federal Aviation

[10] During the calibration process, the ER-2 aircraft would need to be on autopilot because of the required altitude. Glenn officials are not sure whether the ER-2 would then have the control needed for accurate solar cell calibration.

[11] A hot bench emulates the aircraft, allowing instruments to be calibrated in advance.

Administration) specifications which could add several thousand dollars for labor and modification kits, depending on the extent of the modifications. Current estimates are $43,000 for labor and $66,000 for modification kits.

Use of the Lear will also incur costs for flying the aircraft from Langley Research Center several times a year to conduct the solar cell research at Glenn. The increase in costs could result in a decrease in research because the budgets will be consumed faster. If the Dryden ER-2 aircraft is used, travel costs would still increase because the Glenn researchers with the responsibility for solar cell calibration will have to fly to Dryden several times a year.

Researcher Productivity Could Decrease. Because flights are controlled by atmospheric conditions, if the conditions are not right for the scheduled type of research, the aircraft do not fly. The conditions are generally determined the day of the planned flight. Currently, if a planned flight does not take place because the atmospheric conditions are not right for the research, the researchers are able to perform other work at Glenn. However, if the planes are transferred elsewhere, the researchers may not have alternative work they can do away from their laboratories. Consequently, researcher productivity could decrease if the aircraft are not operated at Glenn.

Glenn Hangar Will Remain Open

Under the current plan, the hangar at Glenn will remain open and will transition from an aircraft operation to a support operation.[12] Glenn expects that the hangar and aircraft support personnel will service approximately 75 to 100 transient aircraft annually. There will be no loss of staffing because personnel will be reassigned to other positions at Glenn and will support the transient aircraft as needed. Therefore, there will not be a considerable cost savings from transferring the Twin Otter and Lear 25 to other locations. If flight operations are stopped, Glenn should perform a cost-benefit analysis to assess the continuing need for the hangar.

Conclusion

NASA's plan to relocate the current research aircraft is not adequately supported by an evaluation of all alternatives, including cost-benefit analyses and program impact analyses to identify the best alternative to support the research mission. Safety is a consideration, and the research flights, particularly for icing research are inherently risky. However, the overall goal of the icing research program is to improve aviation safety.

NASA should evaluate the alternatives and identify the most efficient and effective method to meet the program needs. Further, the Agency should develop a long-term plan for the icing program and decide the best approach for achieving the goals set forth in the plan.

[12] As a support operation, Glenn would perform mostly administrative work, park transient airplanes, and refuel transient airplanes. Glenn personnel would not perform major maintenance work on aircraft.

Recommendations, Management's Response, and Evaluation of Response

The Associate Administrator for Aerospace Technology should:

1. **Develop a long-term plan for the icing research program that provides for both safe and effective research performance.**

Management's Response. Concur. Icing research is a project of the Aerospace Technology Research and Technology Base Aviation Operations Systems (AOS) program. The AOS program has a long-term plan (goals, objectives, milestones and resources) with icing research based on an icing workshop in 1998. The icing research project is revising the project plan. The AOS subcommittee of the Aerospace Technology Advisory Committee will review the draft plan, and recommendations resulting from this review will be incorporated in the final project plan. The final report plan is expected to be approved in November 2000 depending on final congressional authorization and appropriation.

The complete text of management's response is in Appendix B. Management also provided general comments on the report, which are addressed in Appendix C.

Evaluation of Management's Response. The actions taken and planned by management are responsive to the recommendation. The recommendation is resolved, but will remain undispositioned and open until agreed-to corrective actions are completed.

2. **Perform a safety and programmatic evaluation including a cost-benefit analysis of alternatives for performing the flight research program. The analysis should consider the cost to keep the research aircraft at Glenn and evaluate the cost of maintaining the Glenn hangar to support transient aircraft.**

Management's Response. Concur. Management agreed to conduct a cost-benefit analysis to appropriately assess the resources, (cost, workforce, and vehicles) needed to meet the project goals. The analysis will include the expected costs to maintain the flight research capability at Glenn or elsewhere. Management expects to complete the cost-benefit analysis before the end of the calendar year. Management also responded that cost would not be the only factor in its decisions, particularly in regard to safety (see Appendix B).

Evaluation of Management's Response. We realize that cost alone is not the only determining factor for a decision regarding flight research, and we revised the recommendation in the final report to include a safety and programmatic evaluation. The actions taken and planned by management are responsive to the revised recommendation. The recommendation

is resolved, but will remain undispositioned and open until agreed-to corrective actions are completed.

3. **Suspend aircraft transfer plans until a cost-benefit analysis of the alternatives has been performed and an adequate long-term plan for conducting the research has been prepared.**

Management's Response. Concur. There will be no transfer of aircraft from the Center prior to completion of the cost-benefit analysis and preparation of a long-term research plan (see Appendix B).

Evaluation of Management's Response. The actions taken and planned by management are responsive to the recommendation. The recommendation is resolved, but will remain undispositioned and open until agreed-to corrective actions are completed.

4. **Consider resumption of Glenn research flight operations after a follow-on assessment is performed of corrective action for previously identified deficiencies.**

Management's Response. Concur. Glenn will continue to conduct flight operations to maintain the minimum aircraft airworthiness and flying proficiency for its pilots. Thus the pilots are prepared to resume flight research operations if needed, based on the cost- benefit analysis, and needs identified in the project plan (see Appendix B).

Evaluation of Management's Response. The actions taken and planned by management are responsive to the recommendation. The recommendation is resolved, but will remain undispositioned and open until agreed-to corrective actions are completed.

Appendix A. Objectives, Scope, and Methodology

Objectives

The overall objective was to evaluate NASA's decision to discontinue research flight operations at the Glenn Research Center. Specifically, we assessed whether NASA has: (1) sufficiently justified the decision to terminate the research flight operations and (2) adequately assessed alternatives to conducting research flight operations.

Scope and Methodology

We interviewed officials at NASA Headquarters and at Glenn who were involved in the decision to cease the research flights based at Glenn. We interviewed personnel involved in aircraft operations as well as in the icing research and solar cell calibration programs to identify program goals and potential impacts if the aircraft are transferred to other locations.

We reviewed available documentation, dated March 1998 through February 2000, on the program impacts and on the costs associated with the flight research program. We also reviewed the response to a congressional request prepared by NASA management to explain the basis of the decision.

Review Field Work

We performed the field work for this review from February through March 2000 at NASA Headquarters and at the Glenn Research Center.

Prior Audit Coverage

NASA performed the Zero Based Review in response to dramatic decreases in the NASA budget. The Zero Based Review recommended the consolidation of all NASA science platform and research aircraft at Dryden in order to streamline infrastructure and improve efficiency of its aeronautics programs. In August 1996, the NASA Office of Inspector General issued a report on the Audit of Aircraft Consolidation at the Dryden Flight Research Center (Report Number HA-96-007). The objective of the 1996 audit was to determine the reasonableness of assumptions underlying NASA's consolidation plan and the accuracy of subsequent cost assessments performed by the NASA's Comptroller office. The audit found that the proposed consolidation was neither cost-effective nor an efficient use of Agency resources. Many of the assumptions and cost savings projections were optimistic, and the associated cost estimates did not adequately reflect actual cost history. The audit also found that NASA had not adequately evaluated the effects that aircraft consolidation would have on research programs.

Appendix B. Management's Response

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of: R

JUN 20 2000

TO: W/Assistant Inspector General for Auditing

FROM: R/Associate Administrator for Aerospace Technology

SUBJECT: Response to Draft Report: Review of Flight Operations at the Glenn Research Center, May 16, 2000 (Assignment No. A0002700)

Enclosed is our response to this draft report: Review of Flight Operations at the Glenn Research Center (GRC), May 16, 2000 (Assignment No. A0002700). I would like to commend you on your thorough audit of this issue. The Office of Aerospace Technology and the GRC have coordinated the response to all of the recommendations.

We have concurred on all of your recommendations in the draft report. While safety has always been a high-priority at NASA, the Agency has stepped up its attention to this issue over the past year. In light of this, it is extremely important that we do whatever we can to protect the safety of the public and NASA's employees and not let financial considerations alone drive our decisions. The safety concerns due to the dramatic reduction in flight rate at the GRC is a concern that we must address in coordination of the Nation's icing research needs.

Any questions should be directed to Mr. Benjamin Neumann at (202) 358-4647 or Ms. Suzann Humphrey at (202) 358-1177.

for Samuel L. Venneri

Enclosure

Appendix B

IG Audit of Flight Operations at Glenn Research Center (GRC) – A0002700

Recommendation 1: Develop a long-term plan for the icing research program that provides for both safe and effective research performance.

Concur: Icing research is a project of the Aerospace Technology R&T Base Aviation Operations Systems (AOS) program. The AOS program has a long-term plan (goals, objectives, milestones and resources), with icing research based on an icing workshop in 1998. The icing research project is revising the project plan. This draft plan will be reviewed by the AOS subcommittee of Aerospace Technology Advisory Committee (ASTAC) and recommendations resulting from this review will be incorporated in the final project plan which is expected to be approved in November 2000, dependent on final Congressional authorization and appropriation.

In April 2000, the AOS subcommittee reported to the ASTAC and the FAA's RE&D advisory committee on the AOS program, including icing research. The subcommittee recommended, and the Office of Aerospace Technology (OAT) endorses, that a workshop be held to identify National R&D needs for aviation icing. The workshop will be hosted at the Glenn Research Center in October of this year and will include operators and experts on the subject from around the country. The project plan will reflect the outcome of the workshop.

Recommendation 2: Perform a cost-benefit analysis of alternatives for performing the flight research program. The analysis should consider the cost to keep the research aircraft at Glenn and evaluate the cost of maintaining the Glenn hangar to support transient aircraft.

Concur: We agree and will conduct a cost benefit analysis to appropriately assess the resources, (cost, workforce and vehicles) needed to meet the project goals. .The analysis will include the expected costs to maintain the flight research capability at the Glenn Research Center, or elsewhere. It is important to recognize that cost alone will not be the determining factor for our decisions when it comes to flight research. This is particularly true because safety of the public, NASA pilots and personnel and government assets are at stake. We expect to complete the cost benefit analysis prior to the end of the calendar year. The Glenn Research Center is currently compiling a list of viable alternatives among academic institutions, government agencies and commercial firms that can provide research services to the icing and solar cell projects.

Recommendation 3: Suspend aircraft transfer plans until a cost benefit analysis of the alternatives has been performed and an adequate long-term plan for conducting the research has been prepared.

Concur: There will be no transfer of aircraft from the Center prior to completion of the cost benefit analysis and preparation of a long-term research plan.

Recommendation 4: Consider resumption of Glenn flight research operations after a follow-on assessment is performed of corrective action for previously identified deficiencies.

Concur: The Glenn Research Center will continue to conduct flight operations to maintain the minimum aircraft airworthiness and flying proficiency for its pilots. Thus the pilots are prepared to resume flight research operations if needed, based on the cost benefit analysis and the National workshop, and needs identified in the project plan.

Appendix B

Other notes

In the audit exit conference, we discussed providing you some wording that we felt did not correctly reflect events and had requested that you change some wording for us. These are some of the requests that we had made.

On page 1, paragraph 1, we would request that you change the wording to "We initiated the review due to Center **employees'** and congressional concerns.....

See Appendix C
OIG Comment 1

We also noted the incorrect order of events that leads the reader to assume that the IAOP encountered safety-related issues during their review. This in fact was not the case. Therefore, we believe the text on Page 3, first bulleted paragraph, 2nd sentence should be: **Because of these concerns, flight operations were stopped.** In response to **this action, the Glenn Research Center requested** the Intercenter Aircraft Operations Panel (IAOP) to conduct a review of Glenn's flight operations in February 1999, which raised some questions about management, operations and maintenance.

See Appendix C
OIG Comment 2

In reference to Page 3, 2nd bulleted paragraph, the risk of flying these airplanes is related to the research, regardless of where it is conducted.

See Appendix C
OIG Comment 3

Page 4, 1st bulleted paragraph, Glenn will not fly any research flights that are conducted by CNRC (the Canadian research organization).

See Appendix C
OIG Comment 4

Page 5. In reference to the "Long-term Program Plan' for icing research. Icing research is a project within the Aviation Operations Systems (AOS) R&T Base Program element. The AOS program does have a long-term plan, which includes technical objectives, approach, milestones, and schedules for icing research. The icing research project has prepared a new project plan that is currently under review.

See Appendix C
OIG Comment 5

For technical correctness, the last sentence on Page 5 should read NASA has flown performance flight and **clear air** tests **with artificial ice shapes** that.....

See Appendix C
OIG Comment 6

For technical accuracy, the 2nd paragraph on page 6 should read ...to Glenn for a **few months** a year.....

See Appendix C
OIG Comment 7

Appendix C. OIG Comments on Management's Response

Glenn management provided the following comments in its response to our draft report. Our responses to the comments are also presented.

Management's Comment. On page 1, paragraph 1, change the wording to "We initiated the review due to Center employees' and congressional concerns….

1. OIG Comments. We changed the wording to "We performed the review in response to Center employee and congressional concerns…."

Management's Comment. The incorrect order of events leads the reader to assume that the IAOP encountered safety-related issues during their review. This, in fact, was not the case. Therefore, the text on page 3, first bulleted paragraph, 2nd sentence, should be: "Because of these concerns, flight operations were stopped. In response to this action, the Glenn Research Center requested the Intercenter Aircraft Operations Panel (IAOP) to conduct a review of Glenn's flight operations in February 1999, which raised some questions about management, operations and maintenance."

2. OIG Comments. We changed the report accordingly, and this issue is reflected on page 4 of the final report.

Management's Comment. In reference to page 3, 2nd bulleted paragraph, the risk of flying these airplanes is related to the research, regardless of where it is conducted.

3. OIG Comments. We changed the first sentence of the referenced paragraph to "The Office of Aerospace Technology decided NASA pilots should not be flying in the risky conditions because there is little or no control over where icing could occur on the aircraft." This issue is reflected on page 4 of the final report.

Management's Comment. On page 4, 1st bulleted paragraph, Glenn will not fly any research flights that are conducted by the Canadian research organization.

4. OIG Comments. We changed the report to "NASA pilots will be accompanying some Canadian pilots on icing research flights for a certain period after the transfer."

Management's Comment. On page 5 in reference to the "Long-term Program Plan" for icing research, icing research is a project within the Aviation Operations Systems (AOS) R&T Base Program element. The AOS program does have a long-term plan, which includes technical objectives, approach, milestones, and schedules for icing research. The icing research project has prepared a new project plan that is currently under review.

Appendix C.

5. OIG Comments. We changed the report to "According to Glenn, icing research is a project within the Aviation Operations (AOS) Systems Research and Technology Base Program element. The AOS program does have a long-term plan, which includes technical objectives, approach, milestones, and schedules, for icing research." In another sentence in the same paragraph, the report now states, "Although Glenn officials have prepared a draft long-term plan for conducting icing research, the draft plan…."

Management's Comment. For technical correctness, the last sentence on page 5 should read NASA has flown performance flight and clear air tests with artificial ice shapes that….

6. OIG Comments. We changed the report accordingly, and this issue is reflected on page 6 of the final report.

Management's Comment. For technical accuracy, the 2nd paragraph on page 6 should read …to Glenn for a few months a year….

7. OIG Comments. We changed the report accordingly.

Appendix D. Report Distribution

National Aeronautics and Space Administration (NASA) Headquarters

A/Administrator
AI/Associate Deputy Administrator
B/Chief Financial Officer
B/Comptroller
BF/Director, Financial Management Division
G/General Counsel
H/Associate Administrator for Procurement
J/Associate Administrator for Management Systems
JM/Acting Director, Management Assessment Division
L/Associate Administrator for Legislative Affairs
R/Associate Administrator for Aerospace Technology

NASA Centers

Director, Glenn Research Center
Chief Counsel, John F. Kennedy Space Center

Non-NASA Federal Organizations and Individuals

Assistant to the President for Science and Technology Policy
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Branch Chief, Science and Space Programs Branch, Energy and Science Division, Office of Management and Budget
Associate Director, National Security and International Affairs Division, Defense Acquisitions Issues, General Accounting Office
Professional Assistant, Senate Subcommittee on Science, Technology, and Space

Chairman and Ranking Minority Member – Congressional Committees and Subcommittees

Senate Committee on Appropriations
Senate Subcommittee on VA, HUD, and Independent Agencies
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Senate Subcommittee on Science, Technology, and Space
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House Subcommittee on VA, HUD, and Independent Agencies
House Committee on Government Reform
House Subcommittee on Government Management, Information, and Technology
House Subcommittee on National Security, Veterans Affairs, and International Relations
House Committee on Science
House Subcommittee on Space and Aeronautics, Committee on Science

Congressional Members

Honorable Mike DeWine, U.S. Senate
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NASA Assistant Inspector General for Auditing
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Report Title: Review of Research Flight Operations at the Glenn Research Center

Report Number: _____ **Report Date:** _____

Circle the appropriate rating for the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	N/A
1. The report was clear, readable, and logically organized.	5	4	3	2	1	N/A
2. The report was concise and to the point.	5	4	3	2	1	N/A
3. We effectively communicated the audit objectives, scope, and methodology.	5	4	3	2	1	N/A
4. The report contained sufficient information to support the finding(s) in a balanced and objective manner.	5	4	3	2	1	N/A

Overall, how would you rate the report?

Excellent Fair
Very Good Poor
Good

If you have any additional comments or wish to elaborate on any of the above responses, please write them here. Use additional paper if necessary. _____

_____

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How did you use the report? _____

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How would you identify yourself? (Select one)

Congressional Staff	Media
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Government: _____ Federal: _____ State: _____ Local: _____

May we contact you about your comments?

Yes: _____ No: _____

Name: _____

Telephone: _____

Thank you for your cooperation in completing this survey.

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